WE CLAIM:

1. An apparatus for equalizing channel powers of a multichannel optical signal comprising:

an optical demultiplexer for demultiplexing the multichannel optical signal into a plurality of single channel optical signals,

for each single channel optical signal a respective nonlinear optical limiter which is adapted to limit the single channel optical signal to produce a limited single channel optical signal; and

an optical multiplexer for multiplexing the limited single channel optical signals to produce an equalized multichannel optical signal.

2. An apparatus according to claim 1 wherein each nonlinear optical limiter has a limit transmission power such that the limited single channel optical signal is limited to a power less than or equal to the limit transmission power.

3. An apparatus according to claim 2 wherein the limit transmission powers of the nonlinear optical limiters are equal.

4. An apparatus according to claim 2 wherein each nonlinear optical limiter is adapted to produce a limited single channel optical signal according to an optical limiting power transfer curve applied to the respective single channel optical signal, said optical limiting power transfer curve providing a piecewise increasing monotonic transmitted power function portion when incident light upon the nonlinear optical

limiter has a power less than an incident light critical power, and providing a relatively flat transmitted power function portion when incident light upon the nonlinear optical limiter has a power greater than the incident light critical power, and wherein the limit transmission powers of the nonlinear optical limiters are defined by said relatively flat transmitted power function portion.

5. An apparatus according to claim 4 wherein the piecewise increasing monotonic transmitted power function portion has a steeper transmitted power function portion having a slope of greater than one whereby sides of optical pulses of the respective single channel optical signal are corrected.

6. An apparatus according to claim 5 wherein the piecewise increasing monotonic transmitted power function portion has a transmitted power function portion which limits the power of the respective single channel optical signal to an insignificant transmission power for incident light upon the nonlinear optical limiter having a power less than an incident light power threshold, wherein the incident light power threshold is less than said incident light critical power.

7. An apparatus according to claim 1 further comprising an amplifier for amplifying the multichannel optical signal.

8. An apparatus according to claim 1 wherein the optical demultiplexer is adapted to amplify the multichannel optical signal.

9. An apparatus according to claim 1 further comprising:

for each single channel optical signal a respective bias optical signal source providing to the nonlinear optical limiter a respective bias optical signal of a wavelength

different from each of the single channel optical signals, each bias optical signal having a power, each limited single channel optical signal having a power which has a dynamic range;

wherein the power of each bias optical signal controls the dynamic range of the power of the respective limited single channel optical signal produced by the respective nonlinear optical limiter.

10. An apparatus according to claim 9 further comprising:

for each single channel optical signal a respective optical combiner;

wherein each optical combiner combines the respective single channel optical signal with the respective bias optical signal before they are input into the respective nonlinear optical limiter.

11. An apparatus according to claim 1 further comprising:

an isolator adapted to absorb any power of the single channel optical signals which are reflected from the respective nonlinear optical limiter.

12. An apparatus according to claim 9 further comprising:

for each single channel optical signal a respective isolator adapted to absorb any power of the single channel optical signals which are reflected from the respective nonlinear optical limiter.

13. An apparatus according to claim 7 wherein the nonlinear optical limiters are absorptive nonlinear optical limiters.

14. An apparatus according to claim 1 wherein the nonlinear optical limiters are Bragg gratings comprising nonlinear Kerr materials.

15. An apparatus according to claim 11 wherein the nonlinear optical limiters are Bragg gratings comprising nonlinear Kerr materials.

16. An apparatus according to claim 12 wherein the nonlinear optical limiters are Bragg gratings comprising nonlinear Kerr materials.

17. An apparatus according to claim 9 further comprising:

an equalization analyzer; and

a bias power controller;

wherein the equalization analyzer determines a respective power measurement for each limited single channel optical signal, the bias power controller controlling the power of each bias optical signal as a function of the power measurements.

18. An apparatus for equalizing channel powers of a multichannel optical signal comprising:

an optical demultiplexer for demultiplexing the multichannel optical signal into a plurality of single channel optical signals,

a broadband nonlinear optical limiter having a respective separate spatial area for each single channel optical signal, said respective separate spatial area adapted to limit the single channel optical signal to produce a limited single channel optical signal; and

an optical multiplexer for multiplexing the limited single channel optical signals to produce an equalized multichannel optical signal.

19. An apparatus according to claim 18 wherein each separate spatial area has a limit transmission power such that the limited single channel optical signal is limited to a power less than or equal to the limit transmission power.

20. An apparatus according to claim 19 wherein the limit transmission powers of the separate spatial areas are equal.

21. An apparatus according to claim 18 further comprising an amplifier for amplifying the multichannel optical signal.

22. An apparatus according to claim 18 further comprising:

an isolator adapted to absorb any power of the single channel optical signals which are reflected from the broadband nonlinear optical limiter.

23. An apparatus according to claim 18 wherein the broadband nonlinear optical limiter is a broadband Bragg grating comprising nonlinear Kerr materials.

24. A method of equalizing channel powers of a multichannel optical signal including:

demultiplexing the multichannel optical signal into a plurality of single channel optical signals,

for each single channel optical signal, producing a limited single channel optical signal using a respective nonlinear optical limiter which is adapted to limit the single channel optical signal; and

multiplexing the limited single channel optical signals to produce an equalized multichannel optical signal.

25. A method according to claim 24 wherein each nonlinear optical limiter has a limit transmission power such that the limited single channel optical signal is limited to a power less than or equal to the limit transmission power.

26. A method according to claim 25 wherein the limit transmission powers of the nonlinear optical limiters are equal.

27. A method according to claim 25 wherein each nonlinear optical limiter is adapted to produce a limited single channel optical signal according to an optical limiting power transfer curve applied to the respective single channel optical signal, said optical limiting power transfer curve providing a piecewise increasing monotonic transmitted power function portion when incident light upon the nonlinear optical limiter has a power less than an incident light critical power, and providing a relatively flat transmitted power function portion when incident light upon the nonlinear optical limiter has a power greater than the incident light critical power, and wherein the limit transmission powers of the nonlinear optical limiters are defined by said relatively flat transmitted power function portion.

28. A method according to claim 27 wherein the piecewise increasing monotonic transmitted power function portion has a steeper transmitted power function portion having a slope of greater than one whereby sides of optical pulses of the respective single channel optical signal are corrected.

29. A method according to claim 28 wherein the piecewise increasing monotonic transmitted power function portion has a

transmitted power function portion which limits the power of the respective single channel optical signal to an insignificant transmission power for incident light upon the nonlinear optical limiter having a power less than an incident light power threshold, wherein the incident light power threshold is less than said incident light critical power.

30. A method according to claim 24 further including before the step of demultiplexing, amplifying the multichannel optical signal.

31. A method according to claim 24 further including:

for each single channel optical signal, providing to the respective nonlinear optical limiter a respective bias optical signal of a wavelength different from each of the single channel optical signals, each bias optical signal having a power, each limited single channel optical signal having a power which has a dynamic range; and

controlling the power of each bias optical signal to control the dynamic range of the power of the respective limited single channel optical signal.

32. A method according to claim 31 further including:

combining the respective single channel optical signal with the respective bias optical signal before producing the limited single channel optical signal.

33. A method according to claim 24 further including:

absorbing any power of the single channel optical signals which are reflected from the nonlinear optical limiters.

34. A method according to claim 24 wherein the nonlinear optical limiters are absorptive nonlinear optical limiters.

35. A method according to claim 24 wherein the nonlinear optical limiters are Bragg gratings comprising nonlinear Kerr materials.

36. A method according to claim 31 further including:

determining a respective power measurement for each limited single channel optical signal; and

controlling the power of each bias optical signal as a function of the power measurements.

37. A method of equalizing channel powers of a multichannel optical signal including:

demultiplexing the multichannel optical signal into a plurality of single channel optical signals,

for each single channel optical signal, producing a limited single channel optical signal using a broadband nonlinear optical limiter having a respective separate spatial area for each single channel optical signal, said respective separate spatial area adapted to limit the single channel optical signal; and

multiplexing the limited single channel optical signals to produce an equalized multichannel optical signal.

38. A method according to claim 37 wherein each separate spatial area has a limit transmission power such that the limited single channel optical signal is limited to a power less than or equal to the limit transmission power.

39. A method according to claim 37 wherein the limit transmission powers of the separate spatial areas are equal.

40. A method according to claim 37 further including before the step of demultiplexing, amplifying the multichannel optical signal.

41. A method according to claim 37 further including:

absorbing any power of the single channel optical signals which are reflected from the broadband nonlinear optical limiter.

42. A method according to claim 37 wherein the broadband nonlinear optical limiter is a broadband Bragg grating comprising nonlinear Kerr materials.